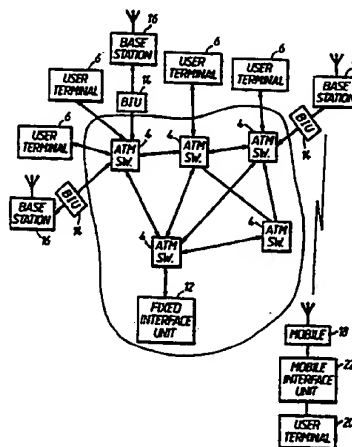




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(71) Applicants (for all designated States except US): ROKE MANOR RESEARCH LIMITED [GB/GB]; Roke Manor, Romsey, Hampshire SO51 0ZN (GB). GPT LIMITED [GB/GB]; New Century Park, P.O. Box 53, Coventry CV3 1HJ (GB).		Published <i>With international search report.</i> <i>Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i>	
(72) Inventors; and (75) Inventors/Applicants (for US only) : HULBERT, Anthony, Peter [GB/GB]; 6 Handley Road, Shirley, Southampton SO1 5AN (GB). McTIFFIN, Michael, John [GB/GB]; 15 Dean Lane, Winchester, Hampshire SO22 5LH (GB). PHILIP, Alexander, Schroder [GB/GB]; Holly House, 31 Highland Road, Wimborne, Dorset BH21 2QL (GB).			

(54) Title: ATM RADIO NETWORK



(57) Abstract

The invention relates to the interface between the normal fixed telecommunications infrastructure and the network which interconnects base stations. A conversion is made between standard ATM cells in the telecommunications infrastructure and half ATM cells in the network which interconnects base stations. However, the half ATM cells in the base station interconnect network would be filled out with some additional signalling and routing information in order to resemble and behave like ordinary full ATM cells. In this way the hardware used in the base station interconnect network could be of the same type as that used in the fixed telecommunications network.

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ATM RADIO NETWORK

The present invention relates to radio infrastructure networks and in particular to those networks which use asynchronous transfer mode cell transmission, which may be used in telecommunications systems.

Telecommunications systems are likely to involve growth in two main areas, namely flexible wideband service capability for cable connected users, and the provision of a large subset of services to mobile users. The flexible wideband service capability may be served by asynchronous transfer mode (ATM) networks to provide an integrated broadband communications network (IBC). This provides flexible data rates up to high peak rates by sub-dividing the data for transmission over the network into small, fixed size packets called cells. The cells consist of 48 bytes of user data in addition to 5 bytes of control information making a total of 53 bytes per cell. ATM networks can support many different services based upon this fundamental transport mechanism. The control information includes identity and routing information which permits transport of the cell from source to destination between intermediate switches along a route set up at the time a call is established.

The extension of some of the higher data rate services to the mobile user requires highly spectral efficient radio technology, such as code division multiple access (CDMA). This allows many users to share the same RF spectrum simultaneously through the use of spread spectrum. The interference environment for reception of any particular user transmission is the sum of the transmission from all

of the users. This is a particularly attractive feature because it provides a measure of decoupling between the total interference level and the activity of individual users. It allows small bursts of data to be transmitted with negligible notice of call set up arbitration, and this feature would be well matched to the flexible responsive transmission of ATM cells in the cable connected network.

An aim of the present invention is to merge the radio interface with the ATM in the fixed infrastructure.

According to the present invention there is provided a radio infrastructure network comprising at least one ATM telecommunications network in which the data to be transmitted is divided into fixed sized packets (cells), characterised in that the ATM telecommunications network is connected to a plurality of user terminals, and to a plurality of base stations by way of respective base station interface units, the base stations communicating by use of radio frequency signals to mobile user terminals, each mobile user terminal being connected to a mobile interface unit, each cell is divided into a plurality of equal length sections and the transmission of data across the base station interface units and the mobile interface units is comprised of data contained in only one of the sections of each cell.

According to a feature of the invention, each cell may be split into two equal lengths and the user data is transported from one half of each ATM cell in individual transmission logical bursts.

An embodiment of the present invention will now be described with reference to the accompanying drawings, in which;

FIGURE 1 shows a radio infrastructure network including an ATM mobile interface;

FIGURE 2 shows a fixed interface unit;

FIGURE 3 shows a queuing function associated with the fixed interface unit; and

FIGURE 4 shows a further radio infrastructure network.

Referring to Figure 1, the radio infrastructure network shown comprises a fixed ATM telecommunications network 2, which includes a plurality of ATM switches 4, interconnected so that each ATM switch can directly communicate with an adjacent ATM switch or can communicate indirectly with another ATM switch via an intermediary switch. Some of the ATM switches 4 are shown directly connected to user terminals 6.

A network 8, similar to the network 2, is shown which similarly comprises a plurality of ATM switches 10, interconnected in a similar manner to the network 2. The network 2 and the network 8 are connected together via a fixed interface unit 12. The fixed interface unit 12 directly connects one of the ATM switches 10 in the network 8 to one of the ATM switches 4 in the network 2. Some of the ATM switches 10 in the network 8 are connected via base interface units 14 to respective base stations 16. The base stations 16 are radio base stations and communicate over an air interface by use of radio signals to a mobile transceiver 18, which is connected to a mobile user terminal 20 by way of a mobile interface unit 22.

In Figure 1, the fixed interface unit 12 and the mobile interface unit 22 are very similar, the essential difference being that the fixed

interface unit 12 must perform interfacing for a large number of links, whereas the mobile interface unit 22 is only handling one link.

The mobile interface unit 22 performs the following functions. For data to be transmitted from the mobile transceiver of Figure 1 to the user terminal 20 of Figure 1, the mobile interface unit is arranged to take two half ATM cells from the interface and create one fixed infrastructure type ATM cell for transmission to the user terminal. In the opposite direction of transmission, the mobile interface unit takes one ATM cell from the user terminal and divides it into two halves for transmission over the air interface.

The base station interface unit 14 performs the following function. Prior to describing this unit, it will be appreciated that the half ATM cells in the base station interconnect network would be filled out with some additional signalling and routing information in order to resemble and behave like ordinary full ATM cells. In this way the hardware used in the base station interconnect network could be the same type as that used in the fixed telecommunication network.

The base station interface unit receives data from the base stations 16 and transmits the data to the ATM network 8. In this direction of transmission the base interface unit takes one logical burst of data from the air interface and pads that data out to create an ATM cell for the mobile infrastructure ATM network. In the opposite direction of transmission, the base interface unit takes one ATM cell from the mobile infrastructure ATM network and strips out the redundant information for transmission over the air interface.

Referring to Figure 2, the fixed interface unit will now be described. The fixed interface unit 12 comprises an ATM multiplexer/de-multiplexer 24 which transmits and receives data from the mobile infrastructure ATM network 8 (Figure 1). The ATM multiplexer/de-multiplexer 24 receives and transmits data to a further ATM multiplexer/de-multiplexer 28 by a bi-directional cell rate converters 26. The ATM multiplexer/de-multiplexer 28 transmits and receives data to the fixed infrastructure ATM network 2 (Figure 1).

The fixed interface unit may include a priority queuing arrangement as shown in Figure 3. The queuing arrangement operates on the transmission of data in the direction of data flow from the mobile infrastructure ATM network to the fixed infrastructure ATM network. The queuing arrangement is situated between the bi-directional cell rate converters 26 (Figure 2) and the ATM multiplexer 28 (Figure 2). The queuing arrangement comprises a plurality of buffer stores 30, each being connected to an input line of ATM multiplexer 28. The input to each buffer store 30 is controlled by a priority allocate circuit 32 which receives information from the bidirectional cell rate converters. All the cells relating to an individual call are placed in a particular buffer. Each buffer is allocated a priority by the circuit 32, and the cells from a buffer of higher priority are selected for transmission in preference to cells within a buffer of lower priority.

The function of the bi-directional cell rate converters will now be described. In the direction of transmission from the mobile infrastructure network 8 to the fixed telecommunication network 2

(Figure 1), the converters are arranged to take two ATM cell from the mobile infrastructure ATM network and strip out the redundant information and combine that information to create one ATM cell for the fixed infrastructure ATM network. In the opposite direction of transmission, the converters take one ATM cell from the fixed infrastructure ATM network and split it into two sections. Each section is padded out with redundant information and radio specific routing information to create two ATM cells for the mobile infrastructure ATM network.

The above approach has the advantages of the ability to use standard ATM hardware for the interconnection required in the radio sub-system. Greater benefits can be achieved if the above concept is extended. If the mobile infrastructure ATM network and the fixed infrastructure ATM network are considered as distinct logical entities but constructed from the same physical hardware, the architecture shown in Figure 1 becomes that which is now shown in Figure 4.

In Figure 4, the blocks which are identical to those in Figure 1 have been given the same reference number and function in the same way.

The network shown in Figure 4, functions in the same way as that described with reference to Figure 1, except the same ATM switches 4 may be used for either traffic of the mobile infrastructure type or traffic of the fixed infrastructure type data. Any traffic which must flow between fixed and mobile terminals is automatically routed via the fixed interface unit 12 for cell splitting/merging. Several advantages are obtained by this method, as follows:-

No additional ATM switches are required. Base stations may be connected to ATM switches in much the same way users registered for wideband services.

Processing operations required for interfacing may be grouped together into large multi-linked fixed interface units, thus providing economy of scale and improvements in trunking efficiency.

Different fixed interfaced units could be included with different roles. For example, the transition between voice in the fixed infrastructure network at 64 kbps and in the mobile infrastructure network at, for example, 8 kbps will require transcoding. One type of fixed interface unit could be dedicated to this operation, and a transcoder would be provided for this purpose. Different cell rate converters would be required as follows.

In the direction of transmission from the ATM multiplexer/de-multiplexer mobile infrastructure ATM network side to the ATM multiplexer/de-multiplexer on the fixed infrastructure ATM network side, the converter will take data from one ATM cell in the mobile infrastructure ATM network and remove the padding. The converter will then transcode from 8 kbps to 64 kbps and then take data from the transcoder and construct four ATM cells for the fixed infrastructure. In the reverse direction the converter would collect four ATM cells from the fixed infrastructure and transcode them from 64 kbps to 8 kbps. The data would then be taken from the transcoder and padded out to create one ATM cell for the mobile infrastructure ATM network.

It will readily be appreciated by those skilled in the art that the above description has been of one embodiment and one example

only. While the description is related to half cells it will be appreciated that any sub-multiple of a cell may be taken and used. Also, other specialised cell rate converters may be used to satisfy any requirement. For example, in the case of video telephony some rate conversion may be required.

CLAIMS:

1. A radio infrastructure network comprising at least one ATM telecommunications network in which the data to be transmitted is divided into fixed sized packets (cells), characterised in that the ATM telecommunications network is connected to a plurality of user terminals, and to a plurality of base stations by way of respective base station interface units, the base stations communicating by use of radio frequency signals to mobile user terminals, each mobile user terminal being connected to a mobile interface unit, and wherein each cell is divided into a plurality of equal length sections and the transmission of data across the base station interface units and the mobile interface units is comprised of data contained in only one of the sections of each cell.

2. A radio infrastructure network as claimed in claim 1, wherein one ATM network is a fixed telecommunications network, having a plurality of ATM switches which may be connected to a respective user terminal, and a further ATM telecommunications network, having a plurality of ATM switches which may be connected to a respective base station by way of a respective base interface unit, the fixed ATM telecommunications network and the further ATM telecommunications network being interconnected by way of a fixed interface unit connecting an ATM switch in each respective network.

3. A radio infrastructure network as claimed in claim 1 or claim 2, in which each cell is divided into two equal length sections.

4. A radio infrastructure network as claimed in any preceding claim, wherein the fixed interface unit includes a queuing arrangement which includes buffer storage means in which cells relating to a particular call are stored in a particular buffer store, and to which buffer store an indication of priority is allocated, such that cells are selected for transmission from a buffer store having a higher priority than those with a lower priority.

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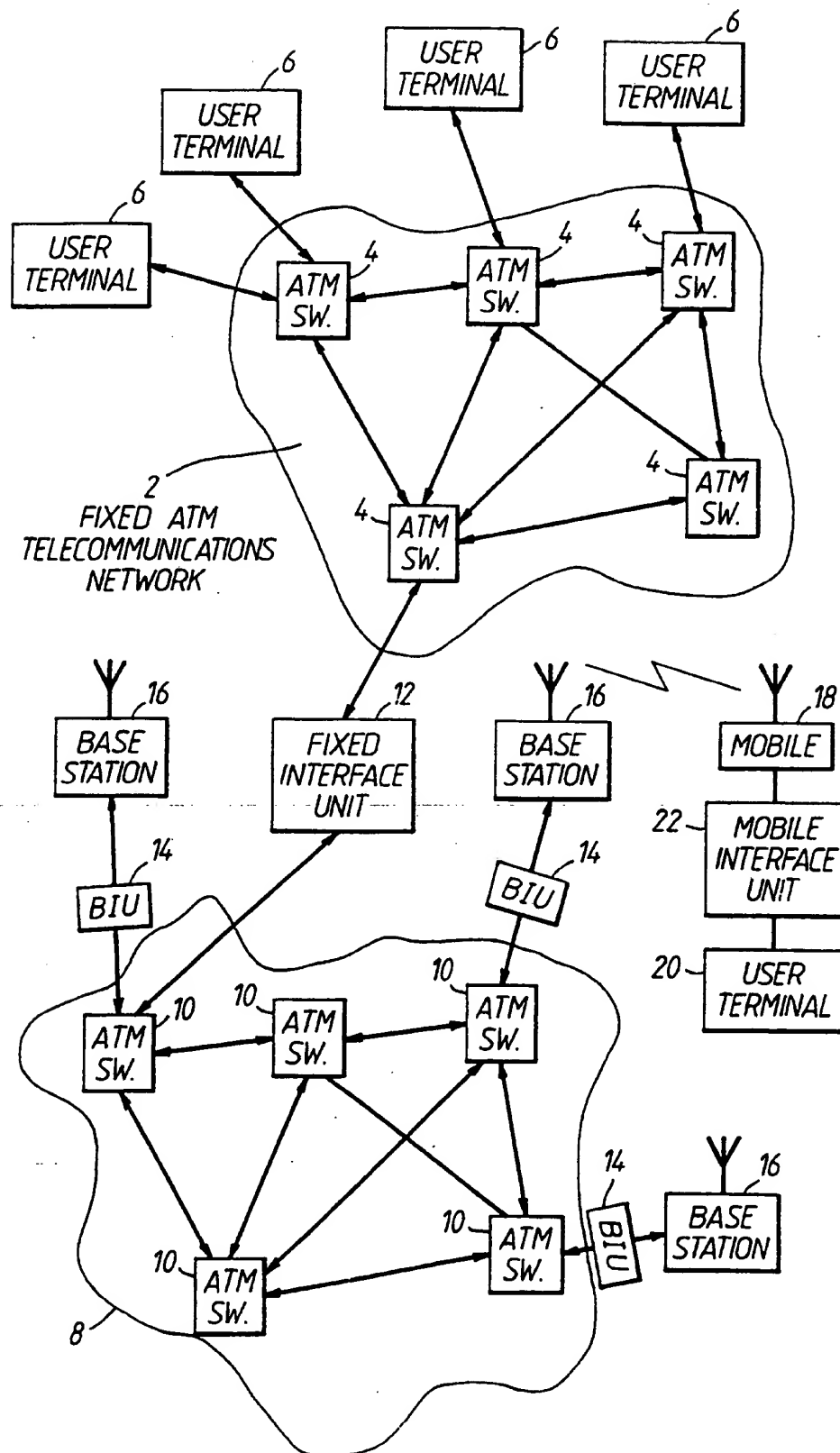


Fig.1.

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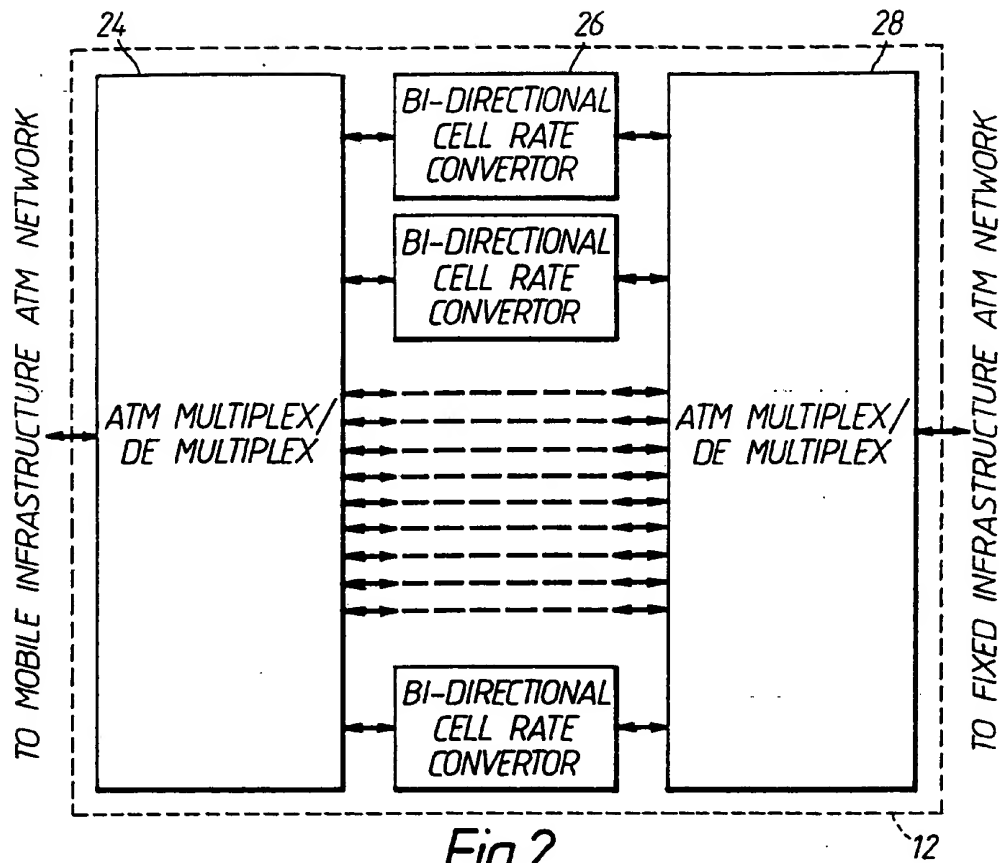


Fig. 2.

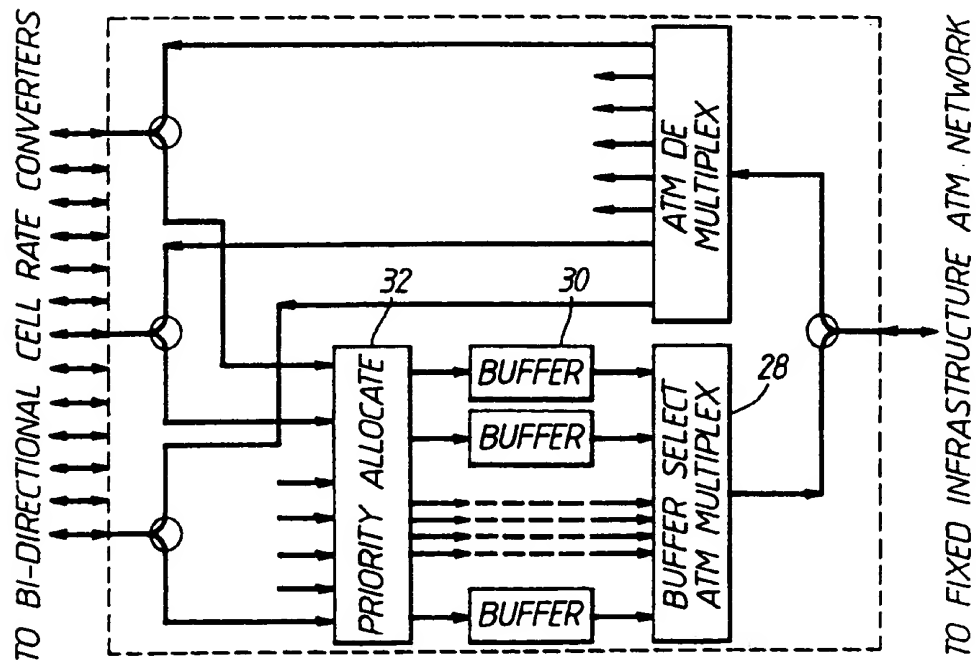


Fig. 3.

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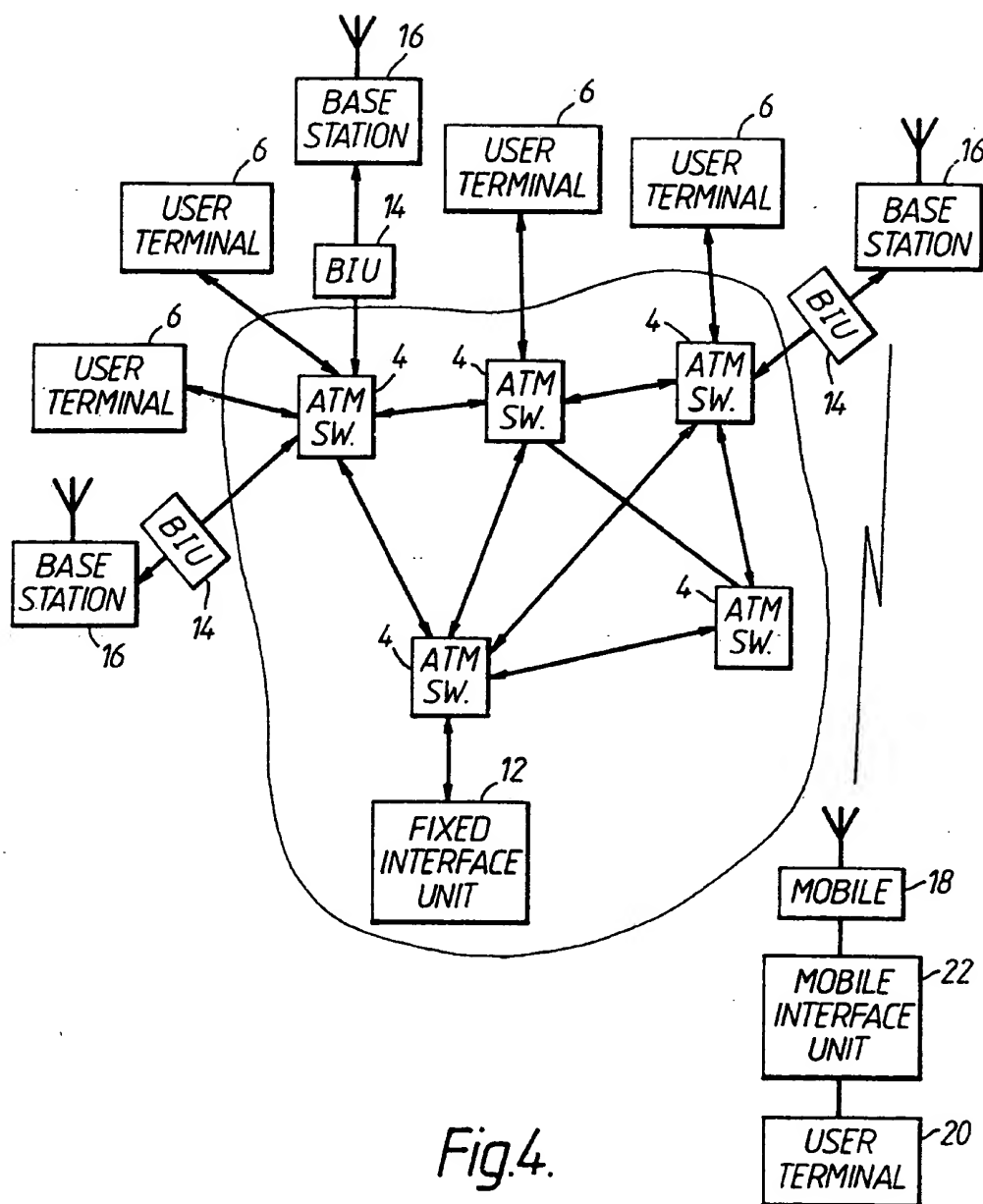


Fig.4.

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INTERNATIONAL SEARCH REPORT

International Application No

PCT/GB 93/00562

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) ⁶		
According to International Patent Classification (IPC) or to both National Classification and IPC		
Int.C1. 5 H04Q7/04; H04L12/56		
II. FIELDS SEARCHED		
Minimum Documentation Searched ⁷		
Classification System	Classification Symbols	
Int.C1. 5	H04Q ; H04L	
Documentation Searched other than Minimum Documentation to the extent that such Documents are included in the Fields Searched ⁸		
III. DOCUMENTS CONSIDERED TO BE RELEVANT⁹		
Category ¹⁰	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³
Y	EP,A,0 366 342 (AT&T) 2 May 1990 see column 6, line 1 - column 9, line 27; figures 1,3,4	1-4
Y	EP,A,0 354 120 (LMT RADIO PROFESSIONNELLE) 7 February 1990 see the whole document	1-4
A	EP,A,0 426 269 (BRITISH TELECOMMUNICATIONS) 8 May 1991 see column 2, line 40 - column 3, line 21; figure 2	1
	-/--	
<p>¹⁰ Special categories of cited documents:</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.</p> <p>"&" document member of the same patent family</p>		
IV. CERTIFICATION		
Date of the Actual Completion of the International Search		Date of Mailing of this International Search Report
12 AUGUST 1993		25.08.93
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EUROPEAN PATENT OFFICE		JANYSZEK J.M.

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)		
Category °	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No.
A	IEEE INFOCOM'88 March 1988, NEW ORLEANS, US pages 771 - 780 SATO ET AL. 'Variable Rate Spech Coding and Network Delay Analysis for Universal Transport Network' see page 771, left column, line 18 - line 47 see figure 19	2
A	----- PATENT ABSTRACTS OF JAPAN vol. 014, no. 496 (E-0996)29 October 1990 & JP,A,22 06 257 (FUTJITSU). see abstract -----	4

**ANNEX TO THE INTERNATIONAL SEARCH REPORT
ON INTERNATIONAL PATENT APPLICATION NO.**

GB 9300562
SA 73669

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report.
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		CA-A- 2000558	28-04-90
		JP-A- 2244850	28-09-90
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